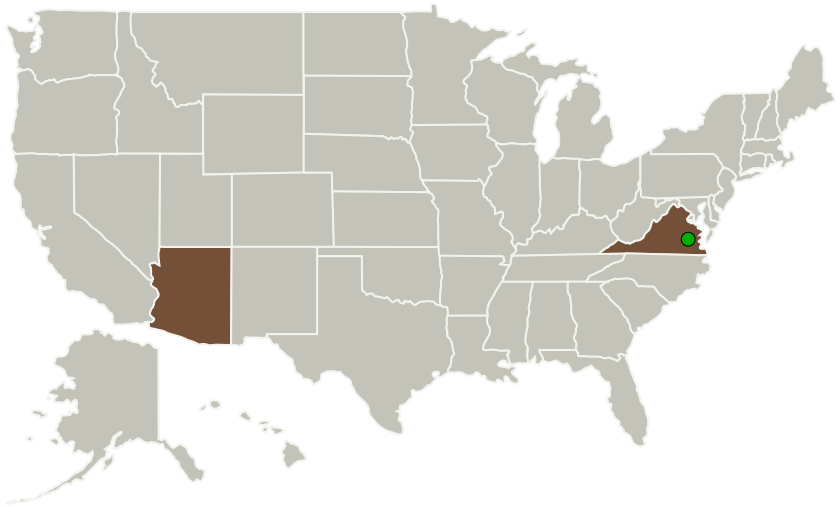
Energy-Deposition to Reduce Skin Friction in Supersonic Applications, Phase II

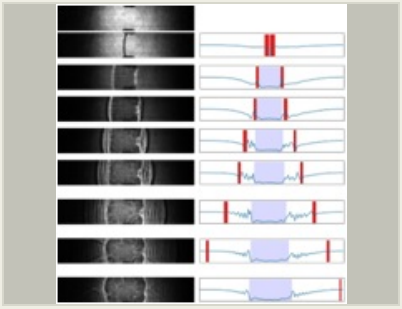
Completed Technology Project (2014 - 2018)

Project Introduction

NASA has drawn attention to an impending need to improve energy-efficiency in low supersonic (M<~3) platforms. Aerodynamic efficiency is the foundation of energy-efficient flight in any regime, and low drag is one of the fundamental characteristics of aerodynamic efficiency. For supersonic aircraft, drag can be broadly decomposed into four components: viscous or skin friction drag, lift-induced drag, wave or compressibility drag, and excrescence drag. The relative impact of these four drag forces depends upon vehicle-specific characteristics and design. However, viscous skin friction drag stands out as particularly significant across most classes of flight vehicles. Therefore, effective techniques to reduce skin friction drag on a vehicle will have a major and far-reaching impact on flight efficiency for low supersonic aircraft. In an effort to address the need for increased aerodynamic efficiency of low supersonic vehicles, PM&AM Research, in collaboration with Texas A&M University, propose to build upon our successful Phase I effort to mature/develop our novel energy deposition technologies, using basic, well-demonstrated energy-deposition techniques along the surface in supersonic flow to control/compress/forcibly-move the boundary layer fluid by creating a low-density "bubble-like" region, thereby reducing the viscous skin friction. Once matured, this solution will reduce the drag experienced by a low supersonic platform, allowing vehicles to exhibit increased aerodynamic efficiency.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Physics, Materials, and Applied Mathematics Research, LLC	Lead Organization	Industry	Tucson, Arizona
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Arizona	Virginia

Project Transitions

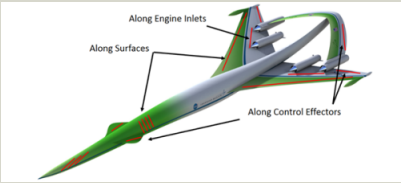
April 2014: Project Start

December 2018: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137629)*

Images



Briefing Chart Image
Energy-Deposition to Reduce Skin Friction in Supersonic Applications, Phase II
(https://techport.nasa.gov/image/126554)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Physics, Materials, and Applied Mathematics Research, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

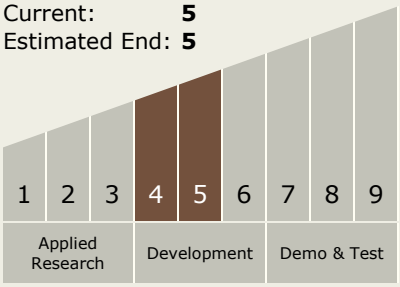
Carlos Torrez

Principal Investigator:

Kevin Kremeyer

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



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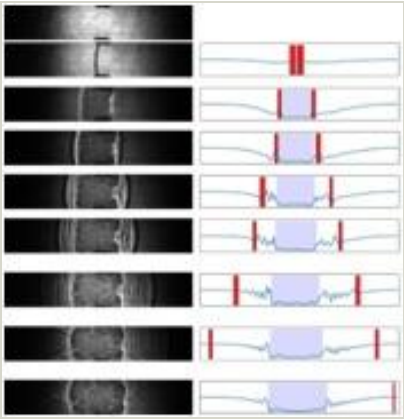

Final Summary Chart Image
Energy-Deposition to Reduce Skin Friction in Supersonic Applications, Phase II
(https://techport.nasa.gov/image/128614)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.1 Aerodynamics

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System